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ORIGINAL PAPER

Increasing Verbal Interaction in Children with Autism Spectrum Disorders Using Audio Script Procedure

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Abstract

This study aimed at investigating the effectiveness of audio script and script-fading procedure in teaching initiation to children with ASD. Three children with ASD and a parent of each child participated in the study. A nonconcurrent multiple baseline design across children was used. The findings showed that the initiation emitted by the children increased during audio script and script-fading procedure. Children also generalized initiation across different conditions and maintained the acquired skills. Finally, the social validity findings showed that the opinions of the parents regarding the procedure were overall positive. Results were discussed in terms of recommendations for practitioners and future research.

Keywords Autism spectrum disorder · Script · Script fading · Communication skills · Initiation

Autism spectrum disorder (ASD) is a neurodevelopmental disorder that is frequently diagnosed in early childhood (Beighley et al. 2013; National Autism Center (NAC) 2015). Deficiencies in social communication and social interaction of individuals with ASD have continually been the main symptoms. As stated by the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association 2013), limitations in initiating and maintaining social interaction, limitation in conversation and understanding, unusual eye contact, using gestures, and shared pretend play or making friends are among verbal and non-verbal social communication problems of individuals with ASD. Social communication skills such as initiating and elaborating conversation are essential for individuals to develop meaningful social relationships. Initiation is defined as verbal responses directed to a conversation partner (CP) before the CP initiates conversation, while elaboration is defined as verbal responses directed to a CP after the CP engages in conversation (Garcia-Albea et al. 2014; Krantz and McClannahan 1998). Individuals with ASD have difficulties in initiating or elaborating verbal interaction (APA 2013). Therefore, it is crucial to identify evidence-based practices in teaching social communication skills, including initiation and elaboration, to individuals with ASD (Akers et al. 2016; Niwayama and Tanaka-Matsumi 2016).

The script-fading procedure (SFP) is one of the evidence-based practices used in teaching verbal interaction skills to individuals with ASD (NAC 2015; Wong et al. 2015). The script is defined as auditory, written, or visual words or sentences that enable individuals with ASD to initiate and elaborate conversation (Krantz and McClannahan 1993). Audio and visual scripts can be prepared using a language level appropriate to children with ASD (Brown et al. 2008; Garcia-Albea et al. 2014). SFP is defined as fading scripts starting from the last word after a child imitates or starts to read written scripts (McClannahan and Krantz 2005). SFP can be used in teaching social interaction, speaking, and asking for help to individuals with ASD, who cannot speak, have just started to speak, have or do not have reading skills (Birkan 2011; Ganz 2007; Holman 2013).

There has been an increase in the number of studies on the effectiveness of the script and SFP (e.g. Gallant et al. 2017; Ganz et al. 2008, 2012; Krantz and McClannahan 1993; Ledbetter-Cho et al. 2015; Sarokoff et al. 2001). Studies demonstrate that the procedure is effective in teaching initiating, commenting or/and asking questions (e.g. Gallant et al. 2017; Ganz et al. 2012; Ledbetter-Cho et al. 2015; Pollard et al. 2012), conversational speech (Grosberg and Charlop 2017), elaboration (Garcia-Albea et al. 2014; Krantz and McClannahan 1998), responding to initiation (Wichnick et al. 2010b; Wichnick-Gillis et al. 2016), making a comment

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(Groskreutz et al. 2015), requesting attention, help, information (Dotto-Fojut et al. 2011; Howlet et al. 2011), and varied requesting (e.g. Brodhead et al. 2016; Sellers et al. 2016). Among these studies, there are few studies showing the effectiveness of SFP in teaching the verbal interaction skills of both initiation and elaboration (Garcia-Albea et al. 2014; Krantz and McClannahan 1998).

Scripts have been incorporated into different items in the environment or strategies such as activity schedules to prompt verbal interaction (Gallant et al. 2017). Akers et al. (2016) reviewed sixteen studies on SFP conducted between 1993 and 2013. Six studies reported that the procedure was applied using activity schedules (e.g. Dotto-Fojut et al. 2011; Krantz and McClannahan 1993; Stevenson et al. 2000; Wichnick et al. 2010a, b). It is notable that SFP was used more in natural settings without using an activity schedule (e.g. Garcia-Albea et al. 2014; Groskreutz et al. 2015) except two studies (Elicin and Avcioglu 2014; Wicknick-Gillis et al. 2016) conducted after 2010. While there are studies aiming to teach initiation to individuals with ASD, there are only few studies that used SFP in home or school settings with peers, siblings, or parents (Betz et al. 2011; Ganz et al. 2012; Grosberg and Charlop 2017; Reagon and Higbee 2009). Reagon and Higbee (2009) investigated the effectiveness of SFP implemented by parents in a home setting in developing play-based verbal interaction skills of individuals with ASD. They found an increase in the initiation of children who communicated with their parents during play. Furthermore, Grosberg and Charlop (2017) taught conversational speech using text-message prompts to children with ASD in a home play setting with siblings and peers. As a result of that teaching, the children learned and generalized the target skill across peers and settings. Ganz et al. (2012) investigated the effects of peer-implemented scripts on middle school students with ASD, intellectual impairment, and speech-language impairment. The researchers revealed that three communication skills increased when peer-implemented scripts were applied by a trained peer but were not generalized to be used by an untrained peer.

In recent years, it has been suggested to use SFP with multiple stimuli (Garcia-Albea et al. 2014) in the natural environmental settings of a child (Akers et al. 2016), which can facilitate generalization across different conditions. Garcia-Albea et al. (2014) investigated the effects of SFP and multiple exemplars on vocal interaction, including verbal initiation and elaboration, by using audio recorders. They found that scripts and multiple exemplars were effective in teaching vocal interaction skills. Furthermore, Gallant et al. (2017) compared two different locations of audio scripts related to the target multi-stimuli and determined that they affected the initiation of verbal interaction by children with ASD. No differences were found between fading an audio script during the device visible and device-not-visible conditions in terms of establishing stimulus control by the target multi-items. Both studies suggested future research for measuring generalization by using novel and multiple stimuli.

Upon investigating SFP studies, it draws attention that graduated guidance (GG), one of the response prompting procedures, is mostly used for individuals with ASD to press a button-activated recorder or point to a textual script, as well as to orient themselves by positioning their bodies to face a conversation partner (Krantz and McClannahan 1993; Garcia-Albea et al. 2014). During graduated guidance, the implementer uses various levels of physical guidance as needed on a moment-to-moment basis to prompt a correct response (Collins et al. 2018). Nowadays, researchers have begun to implement a system of least prompts (SLP), a more systematic procedure than GG in the script procedure. SLP is a process, which consists of at least a three-level prompt hierarchy where the least intrusive prompt is followed by more intrusive prompts (Tekin-Iftar and Kircaali-Iftar 2012). During SLP, a child completes the known steps independently but waits for the amount of assistance needed with the remaining steps (Collins et al. 2018). Only in one study, the script procedure was performed using SLP, and the effects of a novel script-frame procedure on increasing play-based commenting in preschool children with ASD were investigated (Groskreutz et al. 2015). As a result of the above-mentioned procedure, the children with ASD learned to comment about toys, which occurred in the absence of scripts, with untrained play activities. Therefore, it can be suggested that further studies should be carried out using SLP during the script procedure.

In the literature, there are few studies reporting the social validity findings regarding SFP (Dotto-Fojut et al. 2011; Elicin and Avcıoglu 2014; Gallant et al. 2017; Garcia-Albea et al. 2014; Grosberg and Charlop 2017; Howlet et al. 2011; Lee and Sturmey 2014). In these studies, social validity data were collected from parents, teachers, graduate students, and research assistants by using assessment tools such as a questionnaire adapted from the Treatment Acceptability and Rating Form-Revised (Gallant et al. 2017), watching videos of the intervention (Garcia-Albea et al. 2014; Grosberg and Charlop 2017), using surveys (Howlett et al. 2011), and conducting an interview (Elicin and Avcıoglu). The social validity results of these studies regarding the effectiveness of SFP were in general positive. However, further research that collects social validity data in teaching the initiation and elaboration of verbal interaction by using SFP is needed.

Given the information presented above, the aim of this study is to investigate the effects of the audio script and SFP using SLP on increasing initiation by children with ASD and to determine whether they will acquire elaboration by using multiple stimuli in home settings. Thus, the following research questions guided the study: (a) Does SFP increase

the number of initiations by children with ASD, and do children maintain and generalize the target skills across different settings, family members, and toys? (b) Will children with ASD increase the mean number of elaborations by using SFP with multiple stimuli in home settings? (c) What are the opinions of children's parents about verbal initiation and elaboration as well as SFP?

Method

Participants, Conversation Partners, and Implementers

Three boys diagnosed with ASD (Ege, Can, and Ali) participated in the study. Ege received group training in a development support unit of a university on weekdays. He also received individual training for 2 h and group training for an hour a week at a private training and rehabilitation center. Can and Ali received individual and group training for 2 h a week at a private training and rehabilitation center. While Can attended a preschool educational institution for 15 h a week, Ege and Ali attended a preschool educational institution for 2 days a week. The Anadolu-Sak Intelligence Scale (ASIS) (Sak et al. 2016), the Gazi Early Childhood Assessment Tool (Gazi Erken Çocukluk Değerlendirme Aracı—GEÇDA) (Temel et al. 2004), and the Test of Early Language Development-Turkish Version (TELD-TR) (Topbas and Guven 2011) were used to determine the children's IQ scores, their level of development, and expressive and receptive language levels, respectively. The tests were conducted by certified experts attending the certification program of the assessment tools organized by different agencies/universities such as Anadolu University, Maya Academy, and Kim Psychology. All children could follow two-word directions and express themselves with at least two words when asked simple questions or when specifying their requirements. They could imitate at least two-word sentences but experienced difficulty in initiating and maintaining interaction. The implementers asked the children's teachers and parents whether they had all the skills mentioned above, and the authors observed each child during group training. Moreover, the implementer assessed each pre-requesting skill in one session. The children who had the skills mentioned above participated in the study. Detailed information on the participants is presented in Table 1. The code names were used for three children with ASD to protect their privacy.

The children were expected to (a) have verbal imitation skills, (b) follow at least two-word directions, (c) make at least two-word sentences, (d) have fine motor skills, (e) allow physical assistance, (f) be able to participate in an activity for at least 5 min, and (g) be able to recognize the provided stimuli verbally. Furthermore, the following features were determined as the prerequisite features: (a) being diagnosed with ASD by psychiatrists working in a public hospital called Yunus Emre Public Hospital, and (b) not having received SFP training. According to their health reports, all the participants were diagnosed with ASD when they were 3 years old.

In the study, either the mother or father of the children served only as the CP. The CP was defined as an individual who verbally interacts with an individual with ASD during

Table 1 Participant descriptions

Child	Diagnosis	Gender	Age (months)	GECDA	TELD-TR		ASIS
					RLD	ELD	
Ege	Pervasive developmental disorder	M	60	Within the average point in PMG/CD Under the lower borderline in LD At the lower borderline in SED	Under the average point in RLD. Equivalent to 40 months	Poor in ELD. Equivalent to 40 months	81 (Border IQ)-ID
Can	Pervasive developmental disorder	M	82	Under the average point in PMG Under the lower borderline in CD/LD Within the average point in SED	Very poor in RLD. Equivalent to 28 months.	Very poor in ELD. Equivalent to 38 months	74-ID
Ali	Pervasive developmental disorder	M	63	At the lower borderline in PMG Under the lower borderline in CD/LD/SED	Very poor in RLD. Equivalent to 28 months.	ELD is equivalent to 14 months.	74-ID

M Male, *PMG* psychomotor development, *CD* cognitive development, *LD* language development, *SED* socio-emotional development, *RLD* receptive language development, *ELD* expressive language development, *ID* intellectual disability

SFP (McClannahan and Krantz 2005). Before experimental sessions, training sessions were conducted with the mother/father on SFP and their roles. The rules they must follow during the intervention when interacting with their children were explained during these sessions. Training rules included face-to-face training, role play, and feedback regarding the intervention. CPs were expected to (a) emit an instruction to play, (b) not to initiate a conversation in relation to toys, (c) use the scripts determined for the CP that were suitable for the participant's language level, (d) talk enthusiastically, (e) wait for the child to initiate a conversation, (f) give a suitable response upon the initiation and elaboration attempt, (g) start the timer when the child did not initiate a conversation, and (h) give a suitable response upon the initiation and elaboration attempt during the timer duration.

The first author took part in the implementation of the study, while the second author took part in the planning procedure. The first author had a master's degree, while the second author had a Ph.D. degree in the field of special education, in which both authors had experience for multiple years (8 and 18 years, respectively). The fidelity data were collected by students continuing their master's degree in special education.

Setting

Sessions were conducted in a room in each child's home. The floor was covered with a carpet, and the setting was free from distractions apart from the materials of the study. Audio recorders, toys, transparent boxes, a video camera, and a timer were present in the setting throughout the study. The boxes were located in the pre-determined areas during the study. The generalization sessions were carried out in another room at their home.

Materials

The following materials were used in the study: (a) A circle-shaped audio recorder, the compact size of which was about 2″ in diameter and which had a button in the middle, (b) a timer that sounds alarm, (c) transparent boxes for placing toys into them, (c) toys, (d) Velcro for attaching recorders to toys, and (e) a video camera. The implementer made observations in preschool educational institutions on typically developing children, visited toy shops, and interviewed shop assistants about the most preferred toys by preschool-aged children. Three types of toys, different in color, shape, and size, were determined and included in a toy pool to use multiple stimuli. The toys were then itemized in a checklist, on which the opinions of five preschool teachers were obtained as to the most used toys by typically developing children.

The toys were divided into five categories: *vehicles*, *animals*, *musical instruments*, *construction toys,* and *animation characters*, with four different toys in each category. Detailed information on the toys is presented in Table 2. Two different toy sets were assigned to each child by assessing his toy preferences to determine the two most preferred categories. As a result of the preference assessment, assignment of categories was determined to be as follows: *vehicles* and *animation characters* were assigned to Ege, *musical instruments* and *animation characters* were assigned to Can, and *construction toys* and *musical instruments* were assigned to Ali.

Determination of the Scripts

The implementer interviewed the parents to identify their children's expressive language levels and determine the script length. Furthermore, more information on the children's expressive language levels was obtained through the TELD-TR. For ensuring that the scripts were age-appropriate, the implementer took the toys to a preschool class attended by typically developing children. He then recorded the scripts of children playing with toys. After analyzing and writing the scripts down, he took opinions of three experts, each in special education and preschool education departments, on the toys and age-appropriateness of the scripts. A re-organization was made after receiving their feedback. The authors determined that the CPs' scripts were appropriate for the participant's language level after children's scripts were determined. The same procedure was implemented to form the final CPs' scripts.

The scripts were addressed from three different aspects as in the study conducted by Garcia et al. (2014): (a) Identifying the toy: An expression stating what the toy is (e.g. "Look, this is a train."), (b) Description of the toy: An expression related to the toy's feature(s) (e.g. "The plane has wings."), (c) Function of the toy: An expression stating the use of the toy (e.g. "Let's assemble Legos.").

Table 2 The toys used in the study by category

Category	Types of toys			
	Type 1	Type 2	Type 3	Type 4
Vehicles	Train	Digger	Car	Plane
Animals	Dinosaur	Dog	Horse	Duck
Construction toys	Legos	Blocks	Rods	Magnetic construction sets
Musical instruments	Drum	Guitar	Keyboard	Xylophone
Animation characters	Robots	Spiderman	Pepe	Super wings

The CP's scripts were written according to the following three categories as in the study carried out by Garcia et al. (2014): (a) Generic: A general expression related to the toy picked by the children during the intervention (e.g. "I like this toy."), (b) Toy-specific: A specific expression related to the toy picked by the children during the intervention (e.g. "The police car makes a whoop-whoop sound."), (c) Category-specific: An expression related to the category of the toy picked by the children during the intervention (e.g. "I like vehicles a lot."). The scripts of the children and CPs are presented in Table 3.

Experimental Design

A nonconcurrent multiple baseline design across participants was used to investigate the effectiveness of the script and SFP in teaching initiation to children with ASD. The nonconcurrent multiple baseline design aims to reduce the time spent on baseline conditions or increase flexibility to include new behaviors, conditions, or participants when available (Gast et al. 2018).

Dependent and Independent Variables

The definitions of the dependent variable were adapted from the study conducted by Garcia-Albea et al. (2014), and an assessment was made during the intervention according to these definitions, which are presented in Table 4. Initiation

Table 3 Example scripts by conversation partners and children

Category	Sample toy	Script 1		Script 2		Script 3	
		C	CP	C	CP	C	CP
Vehicles	Train	Look, this's a train	A yellow color train	The train has a carriage	True. The train has a long carriage	The train chuff-chuffs	It's nice to travel on a train
Animals	Duck	Let's play with the duck	Let's put the duck in the coop	Look at the duck's beak. It's yellow	Its beak is very big	Ducks quack	Let's quack together
Musical instruments	Drum	Nice. A colorful drum	Yes. This's a very nice drum	I can play the drum	Let's play the drum together	Look. I beat the drum	I also want to beat that drum
Construction toys	Legos	These Legos are beautiful	Yes. These Legos are very beautiful	Let's make a tower with Legos	Let's put all Legos on the top of each other	Let's mount the Legos	It's very fun to play with Legos
Animation characters	Pepe	Look. Here is Pepe	Pepe is a very enjoyable toy	This Pepe is very sweet	Pepe has a very funny hat on	Let's play with Pepe	Let's sing a song for Pepe

CP conversation partners, *C* children

Table 4 Definitions as to verbal initiation and elaboration

Interaction type	Type	Definition
Verbal initiation	Scripted	The child interacts by saying the expression in the audio recorder or the script that the conversation partner has uttered in the previous session(s)
	Unscripted	The child says some of the expressions in the audio recorder or some of the scripts that the conversation partner has uttered in the previous session(s) In unscripted expressions, the child can initiate or maintain communication by adding new words into the scripts by the audio recorder or conversation partner
	Novel	The child says different expressions apart from the scripts
Verbal elaboration	Scripted	The child interacts by saying the same expression in the audio recorder or the same script that the conversation partner utters after the conversation partner starts communication
	Unscripted	The child says some of the expressions by the audio recorder or conversation partner after the conversation partner starts communication. In unscripted expressions, the child can initiate or maintain communication by adding or omitting new words in the scripts by the audio recorder or conversation partner
	Novel	The child says different expressions apart from the scripts after the conversation partner starts communication

was defined as verbal responses directed to a CP before the CP initiates interaction. Elaboration was defined as verbal responses directed to a CP after the CP enters into interaction. Initiation and elaboration were defined in three major categories: scripted, unscripted, and novel expressions.

The independent variable was the audio script and SFP in teaching initiation to children with ASD. In SFP, the following steps were followed: (a) selecting the target stimulus, (b) observing typically developing children, (c) choosing the aim of teaching, (d) writing down the scripts, (e) teaching the scripts, (f) applying the scripts during the target activity, and (g) fading the scripts.

General Procedure

The intervention was implemented in two sessions every day. The implementer ensured that there was at least 1 h between each session. The intervention sessions were conducted 7 days a week. Each session lasted for between 5 and 7 min. We conducted two intervention sessions in 1 day. The implementer conducted intermittent probe sessions prior to the next two intervention sessions in order to measure both the number of initiations and elaborations of verbal interaction. The probe sessions lasted for between 6 and 8 min. During the intervention, the implementer ensured that the child operated the audio recorder and emitted the script(s) by prompting behind him. Two different types of toys from the two toy categories determined as a result of the preference assessment for each child were selected. Two different toys of all types, a total of eight different toys, were placed into the transparent boxes for the intervention sessions. These boxes, which were closed, were placed side by side during the intervention sessions. We asked the child to take toys from the boxes one by one and to play with them. The child was permitted to take the toys from other boxes when he finished the toys in the first box he had chosen. In one session, a total of four trials, one for each toy, were performed.

Baseline and Intermittent Probe Sessions

The CP and the material sets used in the study were present in the setting during the baseline sessions. The CP drew the child's attention to the toys in the boxes by saying, "Now, we'll play with the toys in these boxes. I want you to play with the toys in the boxes. Are you ready?" The CP instructed the child by saying, "Let's play a game," after the child expressed his demand to play with the toys verbally or gesturally. Then, the CP expected the child to go to the area where the boxes were present, pick up a toy, and initiate a conversation regarding the toy by going back to the CP. After the CP instructed the child, the implementer, waited for 5 s for the child to pick up a toy, and for 5 s more so that the child could initiate a conversation by establishing eye contact with the CP or emit a verbal expression to the CP. The CP elaborated a conversation by making appropriate statements when the child initiated a conversation with a verbal expression of at least one subject and a verb (e.g. "Mum, let's hit the drum."). For example, when the child who chose a plane said, "Look, this a big plane," the CP said enthusiastically, "Yes, the wings are very large." When the child did not pick up any toy after the instruction, the implementer guided him towards the boxes by hand to play with a toy. The implementer reinforced the child verbally and socially when he initiated and elaborated the conversation. Furthermore, the implementer reinforced the child verbally with an edible item when he completed playing with the toy at the end of each trial. The procedure was followed until stable data and low variability (i.e. the range of data point values is small) were obtained in at least three consecutive sessions, which were then followed by the intervention sessions.

The intermittent probe sessions were held after two intervention sessions to assess the progress of the children in the study with no prompt. The same procedure as during the baseline sessions was followed in the intermittent probe sessions.

Intervention

The CP and the toys were in the setting before the teaching process, and the child was facing the CP in a way that they could establish eye contact. The CP said, "Now, we'll play with the toys in the boxes. I want you to play with the toys in the boxes. Are you ready?" After receiving an affirmative response from the child verbally or with gestures, the CP gave him the instruction by saying, "Let's play a game." The child was expected to pick up a toy from the box, then listen and repeat the script by activating the audio recorder with respect to the selected toy. When the child picked a toy and imitated the script in the audio recorder, the CP enthusiastically emitted the appropriate statement prepared for himself/herself in relation to that toy. Right after the CP emitted the script, the implementer reinforced the child from behind of him verbally and socially.

The implementer redirected the child by hand to approach the toys and activate the audio recorder through SLP when he did not interact with a toy. SLP was used in the following steps: taking the preferred toy, sitting in front of the conversation partner (CP), activating the audio recorder, looking at the CP, placing the toy in a specified location, and putting the toys in the box after the child completed playing with the toys. The independent gestural (such as pointing at the CP) and physical prompts (such as holding his arms in the direction of the CP) were used as an SLP prompt hierarchy. The implementer provided the child with an opportunity to give independent responses. If the child did not respond correctly within 5 s after picking up a toy,

the implementer presented him with a gestural prompt. The implementer reinforced the child verbally and socially upon a correct response. However, the implementer ensured the child's correct response by presenting a physical prompt if he did not emit a correct response within 5 s. Then, the implementer reinforced the child by following a continuous schedule of reinforcement. Differential reinforcement was used for prompted and unprompted responses after the child started to exhibit independent responses. The implementer reinforced the child enthusiastically by caressing his head and saying, "Well done." in a higher tone upon his unprompted correct responses. On the other hand, he reinforced the child verbally in a lower tone for prompted correct responses. When the child initiated a conversation within 5 s, the CP elaborated the child's initiation. Then, he/she paused for 5 s to provide the child with an opportunity to elaborate a conversation. If the child did not elaborate the conversation within 5 s after the CP's script, the CP activated the timer and gave the child 30 s to play with the toy. When the child elaborated the conversation with the CP within a certain period of time, the CP engaged with the child using appropriate verbal expressions (e.g. when the child said, "There is a white stick here," the CP answered, "This is a good stick."). The CP chose his/her statements carefully according to the child's expressive language level when responding to the verbal interaction. For example, if the child used three-word statements, the CP replied by using statements containing maximum four or five words (McClannahan and Krantz 2005). The trial was repeated if the child did not make an attempt to initiate a conversation. If the child did not initiate the conversation during the repeated trial as well, the session was ended, and a new trial was started. The implementer made the child take a different toy in the new trial after making him leave the toy far from the boxes so that it would not attract his attention.

The implementer prompted the child to leave the toy when the time was up, and the procedure was repeated. During this period, it was ensured that the child initiated verbal interaction in relation to all the toys in the boxes. The implementer used a continuous schedule of reinforcement until the child imitated all the scripts. When the child started to imitate the scripts without a prompt, the schedule of reinforcement was thinned to a fixed-ratio (FR) schedule. The implementer reinforced the child only at the end of the session when he gave independent responses in seven of the eight trials in the FR-4 schedule.

The scripts were faded systematically from the last word and one-by-one when the child started to emit all the scripts independently, as shown in Table 5. At the end of all the fading steps, the audio recorders were removed. However, the implementer reintroduced the faded script when the child made an error in the fading procedure. As soon as the child emitted a correct response, the implementer proceeded to the fading stage. The implementer proceeded to the next fading stage when the child correctly responded to seven verbal initiations in two consecutive sessions or eight in one session. SFP was completed by removing the audio recorder after fading the last word. The intervention was completed when the children met the criterion by exhibiting eight verbal initiations for three consecutive sessions in the intermittent probe sessions.

Table 5 Script fading steps

Steps	Example
Full script	The train has wagons
Step 1: fading last word	The train has…
Step 2: fading last two words	The train….
Step 3: fading full script	Empty audio recorder
Step 4: removing the recorder	Remove the audio recorder

Maintenance and Generalization

Maintenance sessions were held in the 1st, 2nd, and 4th weeks after the intervention was completed. The same procedure as in the probe sessions was followed, apart from the schedule of reinforcement. The implementer reinforced the children for their participation at the end of the maintenance sessions.

Pre- and post-test generalization sessions were held to determine the generalization levels of the children across different settings, people, and toys. Two different generalization data were assessed: (a) within the category, and (b) across the category. Generalization within the category was performed with a different toy not used in teaching. For example, if a plane in the vehicle category was used in the intervention sessions, a different plane was used for generalization. Generalization across the category was performed with the toy category not used in teaching and determined as a result of the preference assessment. For example, if the plane and train in the vehicle category were used in the intervention sessions, the car and the digger in this category were used for generalization across the category. The same procedure as in the probe sessions was followed in the generalization sessions, except the schedule of reinforcement. In these sessions, the implementer reinforced the child at the end of the sessions. The generalization level of the skills was assessed in a different setting (a different room of the house) by a different CP (the mother or father who was not present during teaching) for generalization sessions both within and across the category.

Reliability

The interobserver agreement (IOA) and treatment integrity (TI) data were collected by three research assistants at the Department of Special Education in a university, who had a master's degree at the Department of Teaching Children with Intellectual Disability. All sessions were video recorded. The IOA and TI data were collected in at least 30% of the probe (baseline, intermittent probe, maintenance), teaching, and generalization sessions for each child. IOA was calculated using the point-by-point method (Ayres and Ledford 2014). The mean IOA was 98.3% (in the range from 91.6 to 100%).

The treatment integrity data were collected for both the implementer and the CP in at least 30% of the sessions across conditions. The mean treatment integrity was 95.3% (in the range from 93.3 to 99%) for the implementer and 96.5% (in the range from 94.5 to 99.5%) for CPs.

Social Validity

A subjective evaluation method was used in order to evaluate social validity. Therefore, the opinions of the parents about the target skills and intervention procedure were evaluated in the study. The authors developed a form consisting of seven questions, five and two of which were closed-ended (e.g. Do you think verbal initiation is necessary for your child to learn and appropriate for the age of your child?) and open-ended (e.g. According to your opinion, what is/are the negative aspect(s) of the study?), respectively. The implementer gave the form to the parents in a closed envelope. After the parents filled in the form, they returned it to the implementer, and the data were analyzed qualitatively. A theme such as the positive aspects of the intervention procedure was identified from each question (e.g. According to your opinion, what is/are the positive aspect(s) of the study?). All the parents' opinions under each theme were analyzed, and similar or different opinions under each theme were reported.

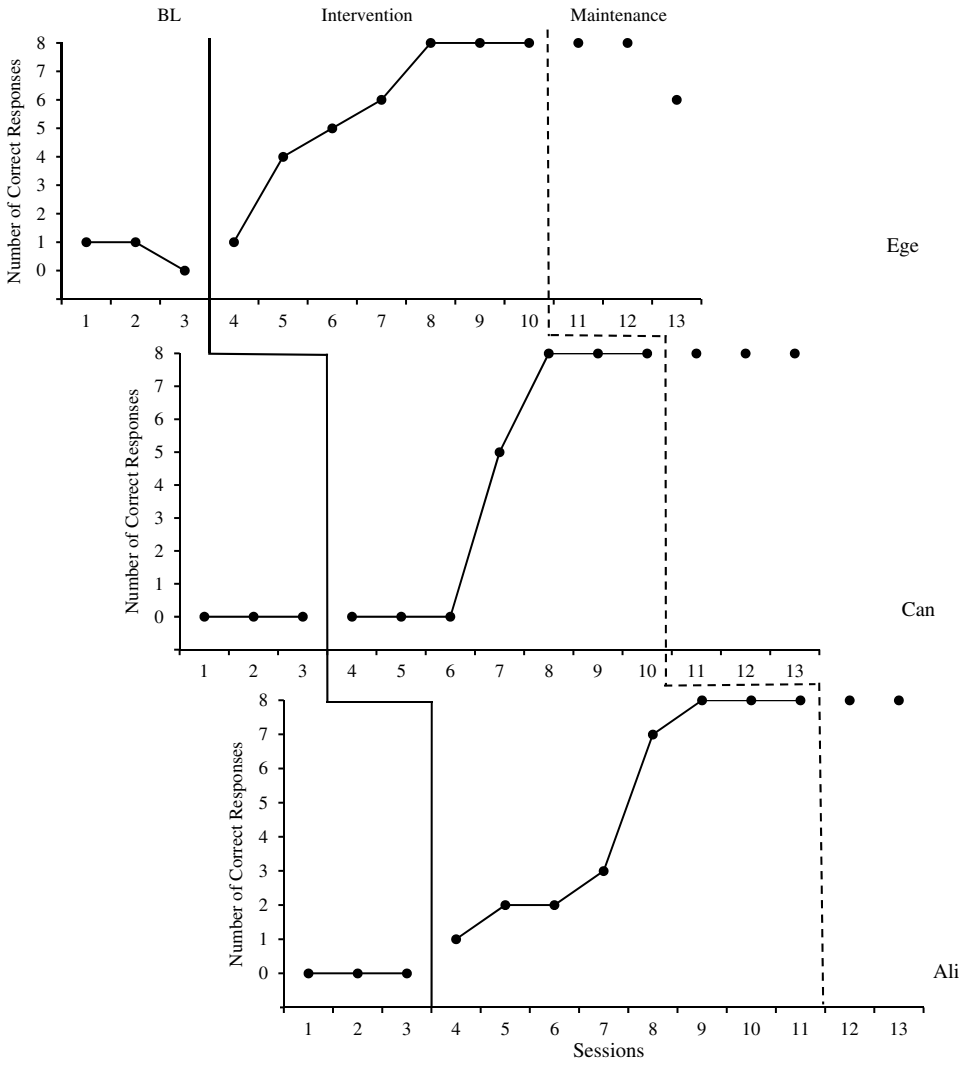

Fig. 1 The number of total initiations during baseline, intermittent probe, and maintenance sessions

Results

The findings on the effectiveness of the audio script and SFP in teaching initiation are presented in Fig. 1. Scripted, unscripted, and novel initiation findings are shown in Fig. 2. Figures 1 and 2 demonstrate the data collected in the baseline and intermittent probe sessions. Furthermore, Fig. 3 shows data on the verbal initiation by the child in the intervention sessions in addition to showing when the scripts were faded during the intervention. For all the children, unscripted initiation increased in the intervention sessions, while scripted initiation gradually decreased. The children initiated a conversation with a limited number of novel initiations in the probe and intervention sessions. Moreover, the number of elaborations by all the children moderately increased under all post-baseline conditions. The following sections present results of verbal initiation and elaboration, maintenance, generalization, and social validity for each child.

Results: Verbal Initiations

The total mean number of initiations for Ege during the baseline sessions was 0.6 (in the range of 0–1), none of which was scripted or unscripted, and 0.6 (in the range of 0–1), none of which was novel. The consistently increasing number of initiations reached the criterion level, 2.8 (in the range of 0–6) for scripted, 1.4 (in the range of 0–4) for unscripted, and 1.4 (in the range of 0–4) for novel initiation, in the fifth intermittent probe session during the intervention. Furthermore, Ege's mean number of novel initiations was 0.8 (in the range of 0–2) in these sessions. 14 intervention sessions and 112 trials in total were performed for Ege.

The mean number of initiations for Can during the baseline sessions was 0 for scripted, unscripted, and novel

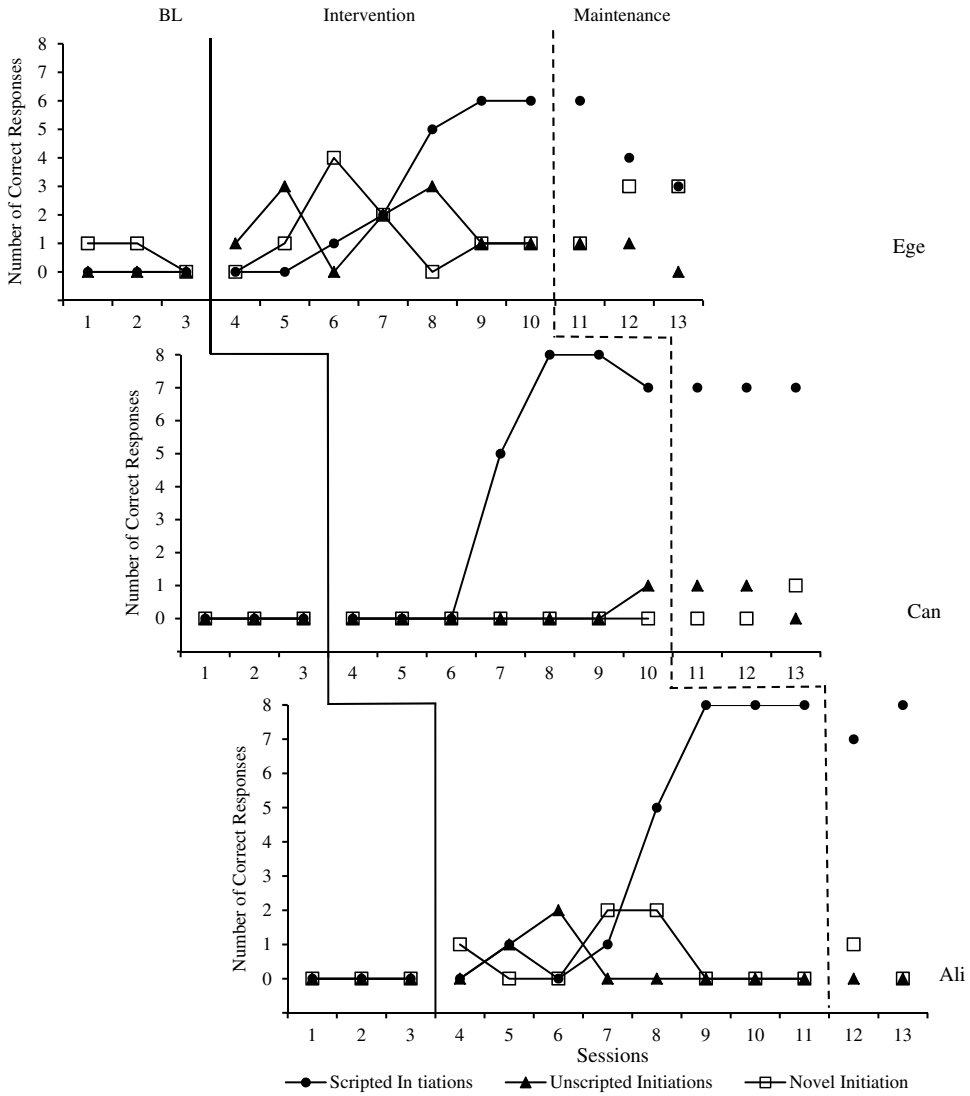

Fig. 2 The number of scripted, unscripted and novel initiations during baseline, intermittent probe, and maintenance sessions

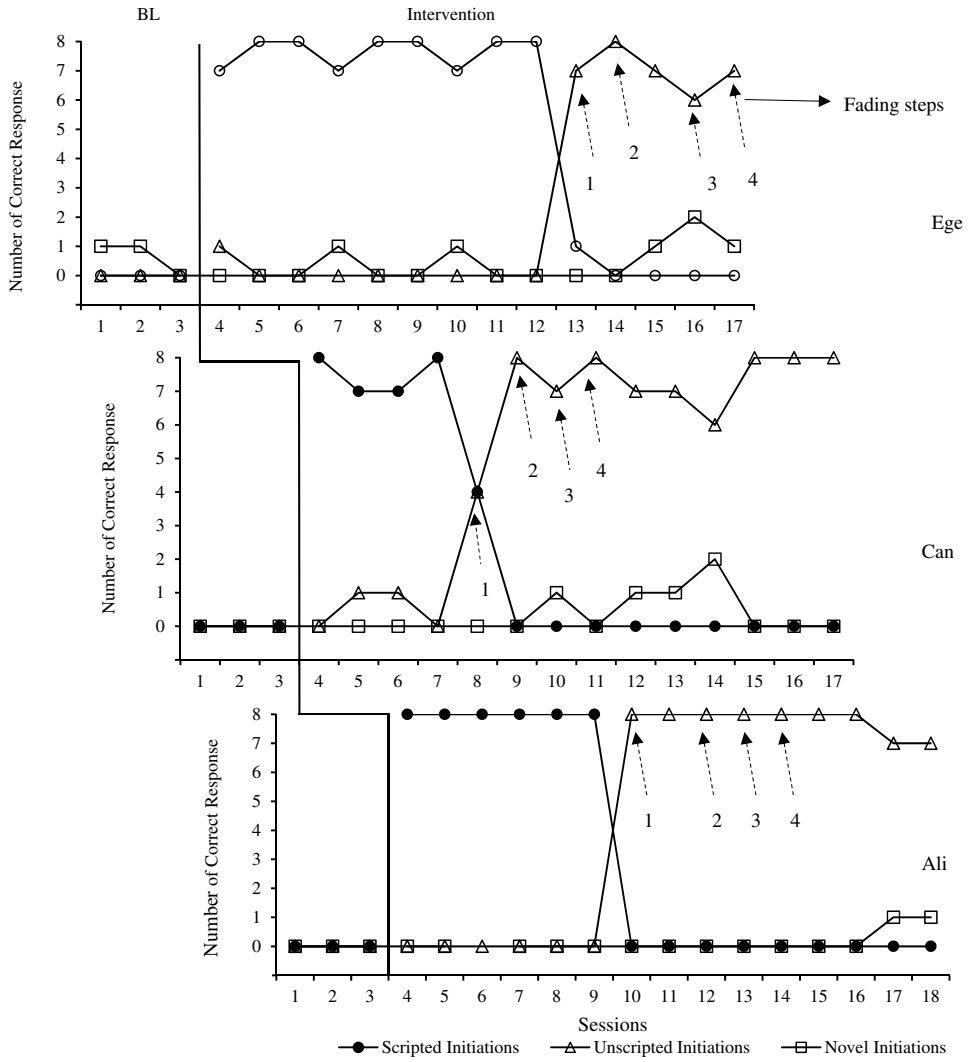

Fig. 3 The number of initiations during baseline and intervention sessions

initiations. No progress was recorded up to the third intermittent probe session, which overlapped with the baseline data. The consistently increasing number of initiations reached the criterion level in the fifth intermittent probe session, only 1 of which was an unscripted statement. Can averaged 0.3 (in the range of 0–2) novel initiations in the intervention sessions. 14 intervention sessions and 112 trials in total were conducted for him.

The mean number of initiations for Ali in the baseline sessions was 0 for scripted, unscripted, and novel initiations. The consistently increasing number of initiations reached the criterion level, 3.8 (in the range of 0–8) for scripted, 0.3 (in the range of 0–2) for unscripted, and 0.6 (in the range of 0–2) for novel initiation, in the sixth intermittent probe session. Ali averaged 0.1 (in the range of 0–1) novel initiations in the intervention sessions. 16 intervention sessions and 128 trials in total were performed for Ali.

Results: Verbal Elaborations

The mean number of elaborations for Ege was 1 (in the range of 0–2) in total, 0 for scripted, 0.3 (in the range of 0–1) for unscripted, and 0.7 (in the range of 0–2) for novel elaboration, during the baseline sessions. He increased the mean number of elaborations to 4.6 (in the range of 0–8) in total in the intervention sessions by averaging 0.2 (in the range of 0–1) scripted, 1.4 (in the range of 0–4) unscripted, and 3 (in the range of 0–8) novel elaborations. He averaged 5.2 (in the range of 0–8) elaborations, 0 scripted, 0.8 (in the range of 0–2) unscripted, and 4.4 (in the range of 0–6) novel elaborations, in the intermittent probe sessions. Furthermore, he elaborated the conversation verbally when putting the toys into transparent boxes at the end of the prescribed session time when he was supposed to play with the toys in the intervention and intermittent probe sessions, but these responses

(i.e. echolalia, vocal stereotype, and statements out of context) were not included in the data since they were outside the specified time. The CP elaborated the conversation by giving suitable responses when the child initiated the conversation with the statement covering at least one subject and one verb (e.g. "Mom, let's hit the drum.") by looking at the CP or directing a verbal statement to the CP after the child selected one of the toys (such as a drum).

The mean number of elaborations for Can in the baseline sessions was 0 for scripted, unscripted, and novel elaboration. He increased the mean number of elaborations to 1.3 (in the range of 0–5) in total in the intervention sessions by averaging 0.1 (in the range of 0–1) scripted, 0.1 (in the range of 0–4) unscripted, and 1.1 (in the range of 0–5) novel elaborations. Can averaged 1.2 (in the range of 0–3) elaborations, including 0 scripted, 0 unscripted, and 1.2 (0–3) novel elaborations, in the intermittent probe sessions. Although he generally elaborated communication by interacting with the toys when playing in the intervention and probe sessions, the data were ignored since he did not elaborate communication by interacting with the CP.

The mean number of elaborations for Ali in the baseline sessions was 0 for scripted, unscripted, and novel elaborations. He increased the mean number of elaborations to 2.7 (in the range of 0–6) in total in the intervention sessions by averaging 0.5 (in the range of 0–2) scripted, 0.1 (in the range of 0–2) unscripted, and 2.1 (in the range of 0–5) novel elaborations. Ali averaged 1.6 (in the range of 0–5) elaborations, including 0.3 (in the range of 0–2) scripted, 0.2 (in the range of 0–1) unscripted, and 1 (in the range of 0–2) novel elaboration, in the intermittent probe sessions.

Maintenance and Generalization Results

The mean number of initiations in the 1st- and 2nd-week maintenance sessions for Ege was 8, including 5 (in the range of 4–6) scripted, 1 (in the range of 1–1) unscripted, and 2 (in the range of 1–3) novel initiations. The number of initiations in the 4th-week maintenance sessions was 6, including 3 scripted, 0 unscripted, and 3 novel initiations. Ege averaged 5 (in the range of 2–7) elaborations, including 0.3 scripted (in the range of 0–1), 0.7 (in the range of 0–1) unscripted, and 4 (in the range of 1–6) novel elaborations. Can averaged 8 (in the range of 8–8) initiations, including 6.6 (in the range of 7–7) scripted, 0.6 (in the range of 0–1) unscripted, and 0.3 (in the range of 0–1) novel initiations, in these sessions. The mean number of his elaborations was 2 (in the range of 1–4), including 0 scripted, 0 unscripted, and 2 (in the range of 1–4) novel elaborations. The mean number of initiations for Ali was 8, including 7.5 (in the range of 7–8) scripted, 0 unscripted, and 0.5 (in the range of 0–1) novel initiations, in the 1st- and 2nd-week maintenance sessions. He averaged 6 (in the range of 6–6) elaborations, including 1 (in the range of 0–2) scripted, 2.5 (in the range of 1–4) unscripted, and 2.5 (in the range of 2–5) novel elaborations.

Generalization findings showed that the number of initiations for Ege, Can, and Ali was 1, 0, and 0, respectively, during the pre-test generalization sessions within the category, which increased to 3, 4, and 4 initiations, respectively, during the post-test generalization sessions. Moreover, the children did not exhibit verbal initiation during the pre-test generalization sessions across the category, whereas the number of initiations for Ege, Can, and Ali was 3, 4, and 4, respectively, during the post-test generalization sessions.

Social Validity Results

The parents' opinions were positive on teaching initiation with the audio script and SFP. All parents (n = 3) agreed that the target skills were necessary for their children to learn and appropriate for the age of their children, who had deficiencies in communication skills. Moreover, two parents indicated that SFP had positive effects on the communication of their children with their peers in different social settings and contexts. All parents emphasized that there was an advancement in elaboration in their children. Moreover, they stated that SFP increased the quality of communication between their children and themselves, and children initiated a conversation when they played games. One parent emphasized that his/her child was always establishing eye contact when communicating with him/her.

Discussion

In the study, the effects of the audio script and SFP on initiation by children with ASD were examined under the control of stimuli present at home as a natural environmental setting, generalization across different settings, toys, and family members, and maintenance. As a result of the study, it was determined that the audio script and SFP were effective in teaching initiation to children with ASD. The findings of our study are consistent with the previous studies demonstrating the effectiveness of the procedure in teaching various communication skills (Brown et al. 2008; Gallant et al. 2017; Garcia-Albea et al. 2014; Krantz and McClannahan 1993; Ledbetter-Cho et al. 2015). The current study examined the effectiveness of the procedure by collecting data not only during intervention sessions in a similar way to previous studies but also during intermittent probe sessions

held before intervention sessions in a different way from these studies. Furthermore, the children's novel initiation levels were low, although Ege and Ali exhibited novel initiation more during the intermittent probe sessions compared to the intervention sessions. Initiation was defined in three major categories: scripted, unscripted, and novel expressions. Since the definition of novel initiation in the present study (i.e. the child says different expressions apart from the scripts) was based on the study conducted by Garcia-Albea et al. (2014), the findings showed similarity. However, Wichnick et al. (2010a, b), and Letbetter-Cho et al. (2015) defined novel initiation as the first formation of an authentic unscripted initiation by a participant. Therefore, it is thought that the findings of the above-mentioned studies are at a higher level than the findings obtained in the present study.

Recent studies have drawn attention to applying SFP in natural settings without using activity schedules (Akers et al. 2016; Garcia-Albea et al. 2014). In addition to effective results obtained in the study conducted in a natural context without using any activity schedules, children with ASD acquired verbal interaction skills in natural settings using SFP. When SFP studies were examined in terms of implementers and settings, it was observed that in only one study parents implemented SFP at home both as implementers and CPs (Reagon and Higbee 2009). Unlike the previous SFP studies, parents served only as CPs. Furthermore, an increasing number of studies involves the presentation of many stimuli such as varied toys within SFP (e.g. Howlett et al. 2011; MacDuff et al. 2007; Pollard et al. 2012; Wichnick-Gillis et al. 2016). Although graduated guidance is mostly used within SFP during script teaching (Garcia-Albea et al. 2014; Krantz and McClannahan 1993; Reagon and Higbee 2009), SLP has become another method for teaching skills to children with ASD in recent years. However, only one study used this method for teaching the target skills (Groskreutz et al. 2015). During the script procedure, SLP was used effectively for the steps of the target skill determined for the usage of scripts, similarly to the study carried out by Groskreutz et al. (2015). In terms of the presentation of many stimuli in a home setting, the presence of parents as CPs, and utterance of SLP, the current study supported and extended previous research.

All the children maintained the acquired skills by exhibiting eight verbal initiations except one child (Ege) who maintained the skill by displaying 6 verbal initiations in the 4th week. The lower maintenance level for Ege may have been explained by the fact that his CP finished up work later than expected and thus was late to the session, and the child was tired. Similarly to the data obtained in this study, the maintenance findings of many studies reported that participants maintained the target skills successfully (e.g. Brodhead et al. 2016; Gallant et al. 2017; Grosberg and Charlop 2017; Howlett et al. 2011), whereas few studies conveyed maintenance data with limited accuracy (e.g. Betz et al. 2011; Ganz et al. 2012; Garcia-Albea et al. 2014).

Generalization findings showed that Ege generalized the target skill by exhibiting three verbal initiations within and across the category, whereas the other two children generalized the target skill by displaying four verbal initiations across different conditions. The reason why Ege generalized the target skill in fewer initiations was the fact that his parent experienced more difficulties in behavior management in the generalization sessions than in the intervention sessions. The findings obtained for Ege supported the previous studies in which generalization accuracy was low (e.g. Argot et al. 2008; Wichnick et al. 2010a), while the findings obtained for the other two children were consistent with the studies in which generalization was provided (e.g. Brown et al. 2008; Reagon and Higbee 2009).

The results obtained from the current study were similar to few SFP studies conducted on both initiation and elaboration (Garcia-Albea et al. 2014; Krantz and McClannahan 1998). In the current study, a little increase occurred in the elaboration of the children, and they usually emitted a novel or scripted elaboration. The children generally emitted similar statements both in the probe and intervention sessions, although they exhibited a novel elaboration, which may have resulted from the fact that they were reinforced upon elaboration during the previous sessions and from their deficiencies in communication skills. However, a higher increase was ensured compared to the elaboration levels in other studies (Garcia-Albea et al. 2014; Krantz and McClannahan 1998).

There are several issues regarding the children (Ege, Can, and Ali) that should be discussed. Firstly, as seen in Fig. 1, while significant changes occurred in the initiation for Ege and Ali, no change was observed in Can's performance by the end of the third intermittent probe session. An adjustment was made for Can by deactivating the sound function of the toys. Thus, the attention of Can was shifted from the sound-making toy to the CP, and the initiation level suddenly increased when playing with five of the eight toys in the fourth probe session. Secondly, as a result of the preference assessment, it was determined that Ali did not want to play with sound-making toys, so batteries of all toys were removed before the intervention. Thirdly, a little increase occurred in the children's elaboration rates. The elaboration rate for Ege was higher compared to the other two children, which may have resulted from the level of interaction with the CPs. Although the children displayed elaboration through a novel elaboration during the intervention and probe sessions, they did not elaborate a conversation through a different novel elaboration in each session.

The social validity findings showed that the parents' opinions about the audio script and SFP were positive. Unlike the previous studies in which social validity data were collected

(Garcia-Albea et al. 2014; Grosberg and Charlop 2017; Howlett et al. 2011; Lee and Sturmey 2014), in the current study, one parent stated that his/her child extended the duration of eye contact and initiated verbal interactions when playing games with his peers. The social validity findings on the increase in the duration of eye contact are remarkable. In this case, looking at the CP may have resulted from the fact that it was among the stages of the script teaching skill and the children preferred their parents as CPs more. No other studies reported any social validity findings on the increase in the duration of eye contact. Moreover, only two studies, among the few studies that measured social validity, assessed mothers' opinions similarly to the present study (Elicin and Avcioglu 2014; Grosberg and Charlop 2017). Other studies collected social validity data from university students and research assistants (Garcia-Albea et al. 2014), administrators and clinicians (Lee and Sturmey 2014), special education teachers and speech pathologists (Howlett et al. 2011), and instructors (Gallant et al. 2017).

The study has some significant limitations. Firstly, the findings of the study were limited to the participants who progressed in initiating and elaborating a conversation despite their expressive and receptive language levels on the TELD-TR. Secondly, toy sets were determined considering the children's preferences, but a limited number of toys, two different toys from two different toy categories, were used in the toy sets. Thirdly, the generalization data were collected in each child's home with a non-CP parent. In this respect, it was not evaluated whether the children could generalize the target skill across other natural settings such as school and other people, including their peers. Fourthly, social validity data were collected only from the children's parents. Finally, only two maintenance data sets could be collected for Ali.

Considering the results, some suggestions can be made for the implementation of the procedure. Firstly, parents and implementers can prefer technological devices such as an audio recorder in teaching audio scripts. Secondly, these scripts can be taught by determining scripts in relation to various types of toys preferred by a child to facilitate interaction between parents, peers, and a child with ASD. Thirdly, elaboration can be taught together with initiation in a natural setting in which parents, implementers, and peers take part as CPs. Fourthly, general or special education teachers may use the audio script and SFP in different activities such as eating and art activity in a natural context. Finally, teaching opportunities that will enable children to make a novel elaboration in a natural context can be provided.

Several suggestions can be made for further research. Firstly, studies on using and fading more scripts can be planned. Secondly, studies on teaching different social communication and interaction skills, such as maintaining interactive communication, can be carried out. Thirdly, studies in which preschool and special education teachers serve as implementers and CPs in general education classes can be designed. Fourthly, two different types of SFP designed by using audio and visual scripts can be compared in terms of their effectiveness. Fifthly, further studies on teaching social communication skills to the small number of subjects can be designed. Finally, SFP can be compared with different evidence-based practices in terms of its effectiveness in teaching verbal interaction.

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

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